

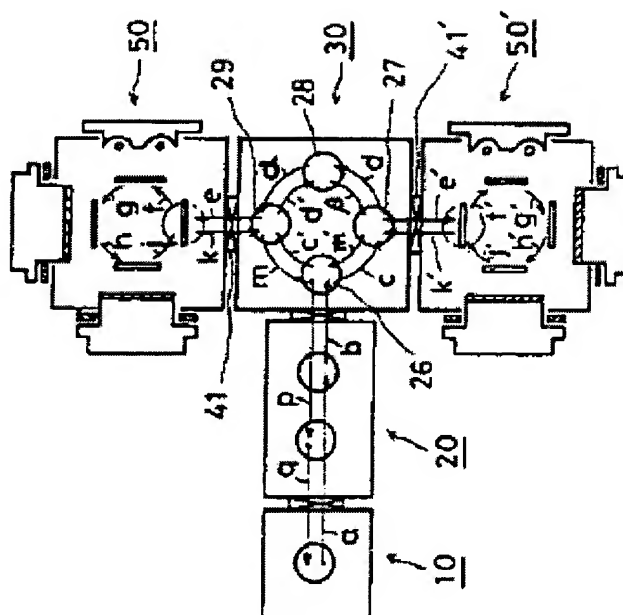
VACUUM THIN FILM TREATING DEVICE

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Abstract of JP60238479

PURPOSE: To improve remarkably the rate of operation of a thin film forming device by providing plural vacuum sputtering chambers for forming a thin film, and operating alternately the chambers in the thin film forming device by sputtering.

CONSTITUTION: When a metallic thin film or the thin film of an insulating material is formed on many substrates of plate-shaped silicon wafers, etc., the substrate is brought into a pretreating chamber 30 through a load lock chamber 10 and an intermediate storeroom 20, transported by stages 26, 27, and 29, heated and etched by a stage 28, then brought into sputtering chambers 50 and 50' which are separated by sluice valves 41 and 41', and sputtered in a vacuum. In this case, sputtering is carried out by using one of both sputtering chambers 50 and 50', and the other sputtering chamber is subjected alternately to periodical maintenance, a preliminary operation, etc. Since sputtering is carried out at all times alternately in one of the two sputtering chambers, the rate of operation with respect to the whole device can be remarkably improved.



⑩ 日本国特許庁(JP)

⑪ 特許出願公開

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審査請求 未請求 発明の数 1 (全5頁)

⑰ 発明の名称 真空薄膜処理装置

⑱ 特 願 昭59-93610

⑲ 出 願 昭59(1984)5月10日

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明 細 書

1. 発明の名称

真空薄膜処理装置

2. 特許請求の範囲

(1) 基体を収容し真空に排気することのできるロードロック室と、該基体に真空中で薄膜処理を施す処理室と、前記ロードロック室と該処理室の間において該基体を自動的に移送する機構を有し、かつ前記薄膜処理の前処理を行なうことができる前処理室との三室からなる真空薄膜処理装置において、該処理室を複数個備え、かつ該基体は該複数の処理室の中から選ばれた少なくとも一つの処理室で薄膜処理を行ない得るよう、前ロードロック室と該複数の処理室の間の該基体の移送経路を選択できるよう構成したことを特徴とする真空薄膜処理装置。

3. 発明の詳細な説明

本発明はスパッタリングにより、同一形状の多数の板状基体にほぼ自動的に薄膜を形成するスパッタ装置の構造に関するものである。更に具体的

的には、本発明はスパッタ装置の保守に起因する装置のダウンタイムを短くし、装置運転の全時間に占める正味の生産時間の比率を大きくとることのできるスパッタ装置の構造に関するものである。

本発明の具体的な応用分野の一例は、無極回路製造工程における薄膜作製過程である。ここでは、例えば直径約125mm、厚み約0.5mm程度の円形薄板状シリコンウェーハの上に、厚み約1ミクロン程度の金属薄膜や絶縁薄膜を形成することが必要とされる。作製すべき薄膜に必要とされる電気的、機械的、物理的諸特性は、一般に真空容器内の不純物ガス分圧が低いほどすぐれたものが得られるので、スパッタリングにより薄膜作製を行う処理室は、可能な限り大気と断ずる時間を短くすることが望ましい。また同じ目的から、処理室には不純物ガス発生の原因となる物体をできるだけ持込まないようにすることが必要であり、持込みはウェーハの移送に最低限必要な物体に限定することが望まれ、理想的には薄膜を作製すべきワ

ューハだけを処理室に移送し、移送の速度が速される。また大量のキューハに均質な処理を効率よく作製するためには、キューハの操作はできる限り作業者が直接手を触れずに自動的に移送処理することが望ましい。更にまた、キューハ表面は所定の厚みの腐蝕のみで被覆されることが必要であり、腐蝕を腐蝕が侵入したりあるいは腐蝕の付着のないピンホール等の発生が避られる。そのため仮に腐蝕が生じても腐蝕処理中はその腐蝕がキューハの表面に堆積しないように、処理室内ではキューハは垂直に保持されることが好ましい。

上述の如き目的に使用されるスベツタ装置の真空系は、基本的には、基体上に薄膜作製を行う処理室と、処理前の基体を大気中から挿入しかつ処理済みの基体を大気中へ搬送するロードロッジ室とで構成される。そして通常は、処理室はその不純物ガス分圧を出来るだけ低く制御するため真空状態に保たれており、ロードロッジ室だけが基体の出し入れの都度大気に通されかつ大気圧から真空に切換され、ロードロッジ室が真空になった状

態ではじめてロードロッジ室と処理室の間の仕切りが開き、それぞれの容室内の基体を基体が移送されるようになっていく。

ところで極めて大量のキューハを長時間にわたって処理する生産工程を考えると、スベツタ装置を長日月に亘り連続して薄膜処理を繰り返すことは先づ常規的には考えられない。即ち、必ず何かの理由により装置を停止し、処理室の真空を放散する必要を生ずる。生産者にとって好ましくないことではあるが、避けられない装置の停止の理由と装置の機能が何らかの事故により失せなくなる場合をあげることができる。装置の信頼性を高める種々の努力により、その事故の発生の確率は実用上問題を生じない程度まで低減することはできているが、経済性などの理由からこれを完全に無くすることはできない。

一般的には、長寿命無故障の装置を長寿命経費で運転することが行われ、むしろ定期的に処理室の真空を放散し積極的に保守作業を行なっている保守作業の内容としては、消耗した古いターゲット

材料の新品との交換、クライオポンプの再生による排気能力の回復、容室内に付着したスベツタ膜の除去、キューハ移送機構機能の再調整等が含まれる。保守作業長、真空処理室は閉じられ再び排気されるが、最初述べたように、所定の品質の薄膜を得るためには処理室の不純物ガス分圧を充分低くすることが必要で、生産に入る前に充分な排気、ベークン、ブリスベツタリングなど長時間の予備操作が行われなければならない。キューハ上に薄膜を作製する正味の生産時間と、それ以外の装置の運転時間、即ち事故により装置が停止した時間とこれを修復する時間とをあらかじめ計画された定期的に保守作業の時間とその後の生産開始までの予備操作に要する時間の合計時間の割合は装置の腐蝕と使用部品の信頼性、装置を運転させた保守作業を行う作業者の操作、作業の適否、処理速度、作製すべき膜に要求される特性の種々の程度等、各種要因の影響を受ける。しかし如何なるスベツタ装置においても、保守作業とそれに続く生産再開のための予備操作の時間が全体の時間に

占める割合は相当大きい。例えば現在用いられている典型的なスベツタ装置では、約33時間をかけて2000枚のキューハを処理すると、その都度処理室の真空を放散し、ターゲット交換を含む保守作業を行うが、保守作業を含めて次の生産再開までに4時間以上を要している。また別のスベツタ装置では約100時間かけて5600枚のキューハの処理するとその都度次の生産までに約10時間の保守作業と予備操作を必要としている。

本発明の目的は上述の問題を解決するスベツタ装置を提供することである。即ち、スベツタ装置運転の全時間に占める正味の薄膜作製時間の割合を大きくできる新型の装置の提供を目的とするものである。

さて、その装置の概要を述べると、この本発明においては一つの真空薄膜処理装置の内部に同じ機能の薄膜処理室を複数個備える。そして装置が通常に運転している間は、その中の第1の処理室で薄膜の処理が行われ、他の処理室は処理のために使用されない。次に所定の計画時間の経過

処理作業が終り、第1の処理室の処理を停止してその真空を再び前述の保守作業を施す段階になると、再処理室すべき蓋体は搬送装置を変更して第2の処理室に入り込まれ、そこで処理が開始される。そして、第2の処理室で処理が行なわれるのに並行して、第1の処理室内では定期的保守作業が行われ、それに就いて処理を開始するための予備操作が行われる。この定期的保守作業と予備操作に費やされる時間は、一般に第1、第2の各処理室が連続作業に耐える時間より短いので、第2の処理室がその処理を停止して保守すべき時期に達したときには既に第1の処理室では処理を再開できる状態になっている。かく、同じ装置をもつ第1の処理室と第2の処理室を交互に使用することにより、切れ目なく再処理の処理を行うことができる。また、この方式によれば予定していない事故が発生して処理室を修理せねばならぬ場合が生じた時にも、それら使用していなかった処理室の方へ処理すべき蓋体を送り込み生産を継続しながら事故を修理することができる。

ンブによりそれぞれ独立に排気され真空に維持される。新しい蓋体はカセット12に収納されてロードロッジ室の入口11からロードロッジ室10に搬入され、また、スパッタリングにより膜付処理が所定条件に達してから取出される。中間収納室20には二組のカセット22、23が設けられている。中間収納室20は、ロードロッジ室10の同様に二つの処理室30及びスパッタ室50の真空の質の劣化を防止すると共に、未処理蓋体と処理済み蓋体の搬送が装置全体の時間当たり処理能力を犠牲にせず行なわれるような役目を果しており、その構成と役割に関する詳細な説明は、特願昭55-169057及び特願昭55-137802の中に与えられている。前処理室30はスパッタ装置製の前段階で蓋体加熱あるいはスパッタエッチング等の予備的処理を行う役割を果す。蓋体は、4個のステージ26、27、28、29のいずれかの上に配置させられる。このうちステージ27は加熱あるいはスパッタエッチングに使用され、ステージ29は冷却等に使用される。ロードロッジ室10、中

上述の説明では、第1、第2の2個の処理室を交互に使用する場合について述べた。一般には同じ装置の処理室が2個あれば連続して生産を行うのに実用上支障はない。しかし、もし同じ装置の処理室を3個以上設ければ、定期的保守操作及び予備操作のために費やす時間が比較的長い場合とか、不測の事故の発生頻度が高い場合には、生産を中断する危険性を極めて低くすることができるといえる。しかし、装置全体としては占有空間の容積が大きくなり、かつ高価になる。これらの点を兼ね合わせ考慮すると実用的には、2個の同じ装置をもつ処理室を設けて連続生産が可能となるような装置が好ましい。しかし本発明は、同じ処理室の数について特に制約を加えるものではない。

次に図面により、更に具体的説明をする。

第1図は、従来の方式のスパッタ装置の一例を示す。図にかいて装置は、ロードロッジ室、蓋体の中間収納室20、即処理室30、及びスパッタ室50で構成され、各室の間に仕切り弁21、31、41が設けられている。各部は図示されていないが

間収納室20、及び前処理室30における蓋体の搬送はベルトを使用した直線運動と蓋体の軸を中心とする回転運動によって行われるが、それらについては特願昭55-151815、特願昭56-35743に詳細に説明されている。

スパッタ室50内では、水平状態の蓋体42(一点鎖線)が、90°回転して43に示す如くほぼ垂直状態に保持され、次いで、その22スパッタ室30の回転中心に有る距離301の周面を約90°ステップで回転する。このスパッタ室30の第2のステージで蓋体44は加熱ランプ51、52により加熱され、第3のステージで蓋体45の上に膜付処理がなされる。同様に第4のステージでも蓋体46の上に膜付処理がなされる。第3及び第4のステージでは蓋体に対向する位置にスパッタ電極60、60'が設けられている。スパッタ電極はターゲット61、カソードボディ62から成り、絶縁体63を介して真空雰囲気面に取付けられている。カソードボディ62にはスパッタ電源70より給電線71、72を經由して(アース電

位に対して)負の高電圧が印加される。ただし金属製真空容器は、アース部81でアースされアース電位にある。図示されていないガス導入系を經由して、スパッタ室50にアルゴン等のガスを供給すると、陰極近傍で低圧ガス放電が生じ陽イオンがターゲット61等を叩く結果、スパッタリングによる薄膜作成が行われる。放電全体の中でカセット12に収容された基体13は矢印aを経て、中間収納室第1カセット23に一度おさまり次いで矢印b, c, d, e, f, g, h, i, k, m, n, pに順次沿って進み、膜付処理後中間収納室20の第2カセット22に戻る。そして再び矢印qに沿ってロードロック室10内の最初のカセット位置に戻る。以上が従来の装置の動きである。

第2図は本発明によるスパッタ装置の実施例を示す。本実施例においてもロードロック室10、中間収納室20の構造とそれらの内部における基体の搬送は前述の従来の場合と全く同じである。前処理室30をわざわざ対称に2個のスパッタ室

50, 51が、それぞれ仕切弁41, 41を介して設けられている。そしていずれか一方のスパッタ室を使用することにより前述と同様の膜付処理ができる。即ち、矢印c, d, a, e, f, g, h, i, k, mに順次沿って基体を搬送することによりスパッタ室50を用いた処理が行うことができ、他方c', d', a', e', f', g', h', i', k', mに順次沿って基体を搬送することにより、スパッタ室50を用いた処理を行うことができる。なお前処理室30のステージ26, 27, 28は基体の調整との間の搬送に用い、ステージ28が加熱あるいはエッチング等の前処理に用いられる。先に述べた如く、本装置を用いて膜付処理を行っている間に、仕切弁41を閉じたままスパッタ室50を大気開放して内部の清浄化、部品及びターゲット等の交換などに似する定期保守作業を行い、その後再び真空に排気して、スパッタ室50の稼働計画時間が終了しスパッタ室50に切換える時期が来るのを待つ。また予期せぬ事故でスパッタ室50を大気に開放せざるを得るような事態にな

る場合には、すぐにスパッタ室50に切換えて生産を長時間中断することなく装置の修理ができる。

以上は本発明の具体的実施例をスパッタ装置によって説明したものであるが、本発明はスパッタ装置に限らず真空を用いる多くの薄膜処理装置に適用できる。特にドライエッチング装置、プラズマCVD装置、真空蒸着装置等はスパッタ装置と同様に薄膜処理中の真空の質が処理の性能に大きな影響を与える。そのため処理室の定期的保守点検の後装置を再び運転するまでには極めて長時間を要しているが、本発明はこの空白時間をゼロにするものである。本発明の生産性向上への貢献は非常に大きく、工業上有為の発明ということが出来る。

4. 図面の簡単な説明

第1図は、従来のスパッタ装置の構成を示す図。

第2図は、本発明のスパッタ装置における実施例の構成を示す。

10…ロードロック室 20…中間収納室
30…前処理室 50…スパッタ室

60…スパッタ室 70…スパッタ室
13, 24, 25, 26, 27, 28, 29, 42, 43,
44, 45, 46は基体を示す。

特許出願人 日電アネルバ株式会社

FIG. 1

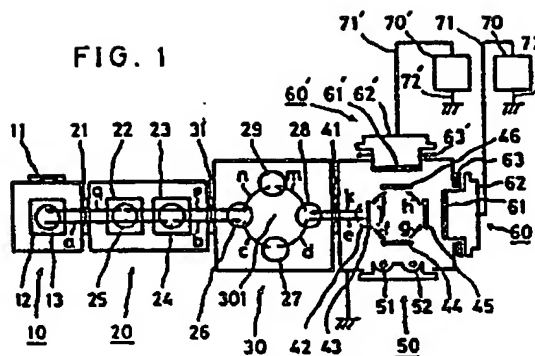
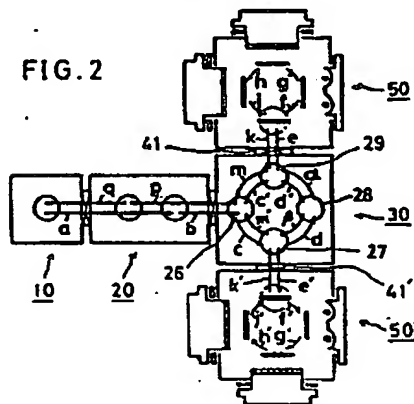


FIG. 2



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Application Date: may 10, 1984
Int. Class Number: C 23 C 14/56
Name of Applicant: ANELVA CORPORATION

SPECIFICATION

1. Title of the Invention:

Vacuum Thin Film Processing Apparatus

2. Claim:

A vacuum thin film processing apparatus, comprising:
a load and lock chamber for storing substrates which can be vacuumed;
processing chambers for implementing a filming process on said substrates in a vacuum; and
a pre-processing chamber disposed between said load and lock chamber and said processing chamber, having a mechanism for automatically transporting said substrates and capable of implementing a pre-processing of said filming process: and
characterized in that said processing apparatus has a plurality of said processing chambers and is constructed so that a transportation path of said substrates between said

load and lock chamber and said plurality of processing chambers can be selected so that the filming process may be implemented on said substrate in at least one processing chamber selected from said plurality of processing chambers.

3. Detailed Description of the Invention:

The present invention relates to a structure of a sputtering apparatus for automatically forming thin films sequentially on a large number of plate substrates having the same shape by sputtering, and more particularly to a structure of a sputtering apparatus which allows to shorten a downtime of the apparatus caused by the maintenance of the apparatus and to increase a rate of net production time in the whole apparatus operating time.

One exemplary field in which the present invention may be applied is a thin film fabricating process in a process for manufacturing integrated circuits. In that process, it is required, for example, to form a metallic thin film and an insulating thin film having a thickness of about $1\ \mu$ on a disc-shaped thin silicon wafer having a diameter of about 125 mm and a thickness of about 0.5 mm. Because the lower the partial pressure of impurity gas within a vacuum container, the better the electrical, mechanical and physical characteristics necessary for the thin films to be fabricated may be obtained in general, it is desirable to shorten a time

exposed to the air as much as possible in the processing chamber for fabricating thin films by sputtering. Also for the same purpose, it is necessary not to bring a material body which may cause impurity gas into the processing chamber. Therefore, it is desired to limit a material body which is brought into the processing chamber to what is just necessary for transporting wafers and ideally, an apparatus having a structure by which only wafers on which thin films are fabricated are brought into the processing chamber is desirable. Further, it is desirable to automatically transport wafers without being directly touched by operators as much as possible when they are handled in order to fabricate uniform thin films efficiently on a large volume of wafers. Further, it is necessary to coat the surface of the wafer only by the thin film having a predetermined thickness and it is not desirable to have fine dust mixed therein or to create pinholes or the like where no film is coated. Due to that, it is preferable to hold wafers vertically within the processing chamber so that no dust deposit on the surface of the wafers, even if dust is produced, during the fabrication of the film.

A vacuum system of the sputtering apparatus used for the purpose described above comprises, basically, a processing chamber for fabricating thin films on substrates and a load and lock chamber for inserting substrates before processing

from the air and for conveying the processed substrates to the air. Normally, the processing chamber is kept in a vacuum state in order to keep a partial pressure of impurity gas as low as possible and only the load and lock chamber is exposed to the air and is vacuumed every time when the substrates are brought in and out. A gate valve between the load and lock chamber and the processing chamber is opened only when the load and lock chamber is vacuumed to transport the substrates between each of the containers.

By the way, in considering a production process for processing an extremely large volume of wafers for a long period of time, it is impossible, from the common sense, to operate the sputtering apparatus for the filming process continuously for a long period of time. That is, the apparatus is always stopped by some reasons, causing a need to destroy the vacuum of the processing chamber. Though it is undesirable for the producer, a case when the function of the apparatus cannot be performed by some failure is one reason of the unavoidable stoppage of the apparatus. Although the probability of causing a failure could have been reduced to the degree which causes practically no problem by making various efforts to improve the reliability of the apparatus, it cannot be completely eliminated from the aspects of economy and others.

Rather, an apparatus having an adequate price is

operated with an adequate cost in general and the vacuum of the processing chamber is destroyed periodically to positively perform maintenance works. The maintenance works include a replacement of a wear old target material with new one, recovery of evacuation ability by refreshing a cryopump, removal of sputtered film adhered within the container, readjustment of a wafer transport mechanism, and the like. While the vacuum processing chamber is closed and is vacuumed again after the maintenance works, the partial pressure of the impurity gas in the processing chamber has to be lowered in order to obtain thin films having a certain quality as described before, so that preliminary operations such as full vacuuming, baking, pre-sputtering and the like have to be carried out taking a long time before entering the production. The rate of the net production time for fabricating thin films on the wafers and the operating time of the apparatus other than that, i.e. the total time of time during which the apparatus is stopped by the failure, time for restoring the apparatus, time of scheduled maintenance works planned in advance and time thereafter necessary for the preliminary operation before starting the production is influenced by various factors such as the structure of the apparatus and reliability of the parts used, propriety of operations and works and skill of the operators operating and maintaining the apparatus, degree of difficulty

of obtaining characteristics required for films to be fabricated and the like. However, the rate of the time for the maintenance and for the ensuing preliminary operations for re-starting the production in the whole time is considerably large in any sputtering apparatuses. For example, in the typical sputtering apparatus presently used, while the vacuum of the processing chamber is destroyed and the maintenance including the replacement of the target is carried out every time when 2,000 wafers are processed taking about 33 hours, it takes more than four hours, including the maintenance, before starting the next production. Another sputtering apparatus requires about 10 hours of maintenance and preliminary operations before the next production every time when 5,600 wafers are processed taking about 100 hours.

Accordingly, it is an object of the present invention to provide a sputtering apparatus which solves the aforementioned problems, i.e. to provide a novel apparatus which can increase the rate of the net time for fabricating thin films in the whole operation time of the sputtering apparatus.

The summary of the apparatus will be described. According to the present invention, a plurality of thin film processing chambers having the same function is provided within one vacuum thin film processing apparatus. During when the apparatus is normally operated, thin films are

processed in a first processing chamber among them and other processing chambers are not used for the processing. Then, in a stage when thin film processing works of predetermined planned time is finished and the processing in the first processing chamber is stopped to break the vacuum thereof to perform the maintenance work described above, the conveying path for sending substrates to be thin film processed is changed to a second processing chamber and processing is carried out in the second processing chamber. In parallel with the processing in the second processing chamber, the periodic maintenance work is done in the first processing chamber and following that, the preliminary operation for starting another processing is carried out. Because the time consumed for the periodic maintenance work and preliminary operation is generally shorter than the time during which the first and second processing chambers can bear the continuous work, the first processing chamber is ready to start processing again at the point when the time has come to stop processing in the second processing chamber to maintain the chamber. Accordingly, the processing of thin films may be carried out continuously by alternately using the first and second processing chambers having the same function. Further, even when an unexpected failure is caused and the processing chamber has to be repaired, this method allows to repair the failure while continuing the production by sending

substrates to be processed to another processing chamber not used till then.

While the case when two processing chambers of the first and second chambers are alternately used has been described in the above explanation, there is practically no trouble in the continuous production by providing two processing chambers having the same function in general. However, the risk of interruption of the production may be lowered to the minimum in cases when the time consumed for the periodic maintenance and preliminary operation is relatively long or when a frequency of causing unexpected failures is high, by providing more than three processing chambers having the same function. However, it increases a volume of the occupied space as a whole apparatus and its price. In considering those points together, an apparatus provided with two processing chambers having the same function and which allows the continuous production is practically preferable. However, the present invention will not particularly limit the number of processing chambers having the same function.

The present invention will be concretely explained hereinbelow with reference to the drawings.

Fig. 1 is a diagram illustrating one example of a prior art sputtering apparatus. In the figure, the apparatus comprises a load and lock chamber 10, an intermediate storage chamber 20, a pre-processing chamber 30 and a sputtering

chamber 50, and gage valves 21, 31 and 41 are provided between each chamber. Each chamber is vacuumed independently by a pump not shown and is kept in the vacuum state. A new substrate is stored in a cassette 12 and is inserted to the load and lock chamber 10 from an inlet 11 of the load and lock chamber 10 and is taken out from there after finishing the filming process by sputtering. Provided within the intermediate storage chamber 20 are two cassettes 22 and 23. The intermediate storage chamber 20 performs roles of preventing the quality of the vacuum in the pre-processing chamber 30 and the sputtering chamber 50 from dropping due to the opening/closing of the load and lock chamber 10 and of conveying non-processed substrates and processed substrates without sacrificing the capacity of the whole apparatus per unit time, and the detailed explanation concerning to the structure and role thereof are given in Japanese Patent Application Nos. 55-169057 and 55-137802. The pre-processing chamber 30 plays a role of implementing preliminary processes such as heating of the substrates and sputter-etching on the pre-stage of the fabrication of the films by sputtering. The substrate is placed on either of four stages 26, 27, 28 and 29. Among them, the stage 27 is used for heating or sputter-etching and the stage 29 is used for cooling, or the like. While the substrates are conveyed through and in the load and lock chamber 10, the intermediate storage chamber 20

and the pre-processing chamber 30 by a linear movement using a belt and a rotary movement centering on an adequate axis, the explanation thereof is given in detail in Japanese Patent Application Nos. 55-151815 and 56-35743.

Within the sputtering chamber 50, a substrate 42 (shown by dashed line) in a horizontal state is rotated by 90° to be held in an almost vertical state as shown by the reference numeral 43 and then is rotated as it is by step of about 90° around a vertical axis 301 which is located almost at the center of the pre-processing chamber 30. A substrate 44 is heated by heating lumps 51 and 52 in a second state in the pre-processing chamber 30 and a filming process is implemented on a substrate 45 in a third stage. Similarly, another filming process is implemented on a substrate 46 in a fourth stage. Sputtering electrodes 60 and 60' are provided at the positions facing to the substrates in the third and fourth stage. The sputtering electrode comprises a target 61 and a cathode body 62 and is mounted on the wall of a vacuum container through an intermediary of an insulator 63. A minus high voltage is applied to the cathode body 62 by a sputtering power supply 70 via feed lines 71 and 72 (to earth potential). However, the wall of the metallic vacuum container is grounded by an earth source 81 and is kept in the earth potential. When a gas such as argon is supplied to the sputtering chamber 50 via a gas introducing system not

shown, a low voltage gas discharge is caused near the cathode and positive ions hit the target 61 and others, forming thin films by sputtering. In the whole apparatus, the substrate 13 stored in the cassette 12 is stored once in the first cassette in the intermediate storage chamber through a path shown by an arrow a and then is advanced sequentially along arrows b, c, d, e, f, g, h, j, k, m, n and p and is returned to the second cassette 22 in the intermediate storage chamber 20 after the filming process. Then, it is returned again to the original cassette position within the load and lock chamber 10 along an arrow q. This is how the prior art apparatus is operated.

Fig. 2 is a diagram illustrating a preferred embodiment of a sputtering apparatus of the present invention. In the present embodiment, the structure and the conveyance of substrates within the load and lock chamber 10 and the intermediate storage chamber 20 are the totally same with the prior art example described above. However, two sputtering chambers 50 and 51' are provided symmetrically interposing the pre-processing chamber 30 therebetween through the intermediary of gate valves 41 and 41', respectively. Then, the same filming process with that described above may be performed by employing either one sputtering chamber. That is, a process employing the sputtering chamber 50 may be performed by conveying substrates sequentially along arrows

c, d, α , e, f, g, h, j, k and m and another process employing the sputtering chamber 50' may be performed by conveying substrates sequentially along arrows c', d', β , e', f' g', h', j', k' and m'. It should be noted that the stages 26, 27 and 29 in the pre-processing chamber 30 are used to convey the substrates between the neighboring chambers and the stage 28 is used for pre-processing such as heating and etching. As described before, while the filming process is performed using this apparatus, periodic maintenance works such as cleaning of the inside and replacement of jigs and targets is carried out by opening the sputtering chamber 50' to the air while closing the gate valve 41' and after that, the chamber is vacuumed again to be ready for the time when the planned operation time of the sputtering chamber 50 ends and the chamber is switched to the sputtering chamber 50'. Further, even when a situation occurs which compels to open the sputtering chamber 50 to the air due to an unexpected failure, the apparatus may be repaired without interrupting the production for a long time by switching to the sputtering chamber 50'.

While the concrete embodiment of the present invention has been explained above, the present embodiment may be applied not only to the sputtering apparatus but also to many thin film processing apparatuses using vacuum. In particular, a dry etching apparatus, plasma CVD apparatus,

vacuum deposition apparatus and the like are similar to the sputtering apparatus and the quality of vacuum during filming process influences significantly to the performance of the processing. Due to that, although it is taking a quite long time before operating the apparatus after the periodic maintenance and inspection of the processing chamber, the present invention eliminate this idle time to zero. The contribution of the present invention to the improvement of the productivity is very large and it can be said that the present invention is an useful invention industrially.

4. Brief Description of the Drawings:

Fig. 1 is a diagram illustrating a structure of a prior art sputtering apparatus; and

Fig. 2 is a diagram illustrating a structure of a preferred embodiment of a sputtering apparatus of the present invention.

In the drawings, the reference numeral (10) denotes a load and lock chamber, (20) an intermediate storage chamber, (30) a pre-processing chamber, (50) a sputtering chamber, (60) a sputtering electrode, (70) a sputtering power supply, (13, 24, 25, 26, 27, 28, 29, 42, 43, 44, 45 and 46) substrates.

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